

**INVESTIGATION OF DIFFERENT HARVESTING
METHODS FOR MICROALGAE *COCCOMYXA SP.*
BIOMASS**

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INVESTIGATION OF DIFFERENT HARVESTING METHODS FOR MICROALGAE *COCCOMYXA SP.* BIOMASS

by

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A dissertation submitted in the partial fulfillment of the requirements for the degree of
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DECLARATION BY AUTHOR

This dissertation is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution.



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LIST OF SYMBOLS AND ABBREVIATIONS

Symbol	Caption
\pm	Plus-minus
$>$	More than
$<$	Less than
%	Percentage
=	Equal to
$^{\circ}\text{C}$	Degree of celcius
Abbreviation	Caption
μm	Micrometer
ANOVA	Analysis of variance
g	Gram
L	Litre
mg	Milligram
mL	Millimeter
nm	Nanometer
rpm	Revolutions per minute
pH	Potential of hydrogen
sp	Species

PENYELIDIKAN PELBAGAI TEKNIK PENUAIAAN BIOMAS MIKROALGA BAGI MIKROALGA *COCCOMYXA SP.*

ABSTRAK

Kaedah penuaian mikroalga kini dapat diklasifikasikan sebagai mekanikal, kimia, biologi, dan elektrik. Pengemparan, flokulasi dan penapisan adalah tiga teknik penuaian yang amat bersesuaian untuk mendapat biomas mikroalga bagi aplikasi seperti biofuel, makanan manusia dan haiwan dan pemulihan kualiti air. Kajian ini meneliti faktor-faktor yang mempengaruhi kecekapan pemulihan biomas mikroalga melalui kaedah sentrifugasi, flokulasi dan penapisan. *Coccomyxa sp.* tempatan telah diasingkan dan dibiakkan untuk penyelidikan dan perbandingan kecekapan penuaian bagi setiap kaedah yang digunakan dalam kajian ini. Berdasarkan hasil kajian ini, kelajuan sentrifugasi sebanyak 5000 rpm dapat meningkatkan peratus penuaian biomas >95% dalam 5 minit. Masa sentrifugasi pada 2 minit ke atas mampu mencapai >90% pemulihan biomas mikroalga manakala masa sentrifugasi lebih lama daripada 5 minit tidak menunjukkan peningkatan yang signifikan dalam peratus penuaian. Kelajuan dan masa sentrifugasi telah menunjukkan kesan yang signifikan ($P < 0.05$) terhadap kecekapan penuaian menurut ANOVA sehala. Bagi kaedah flokulasi, peningkatan pH kultur mikroalga sehingga 10 menyebabkan autoflokulasi *Coccomyxa sp.* dan 73.65% penuaian biomas telah dicapai pada pH 11. Namun, tiada pengaruh yang signifikan dari pH 5-9 untuk pembentukan flock mikroalga. Penggunaan flokulan bukan organik (CaCl_2) pada pH 11 menghasilkan peratus penuaian biomas >90% pada kadar hanya 10 mg/L CaCl_2 . Peratus tertinggi telah diperoleh pada 150 mg/L CaCl_2 , iaitu 99.62%. Kedua-dua pH dan konsentrasi mempunyai kesan yang signifikan terhadap peratus penuaian biomas mikroalga. Selain itu, kaedah penapisan berjaya mencapai peratus penuaian biomas yang tertinggi sebanyak 99.65% dengan

menggunakan penapis mikrofiber kaca dengan ukuran pori 1.2 μm . Namun, kaedah tersebut memerlukan masa yang lebih panjang daripada kaedah lain yang digunakan dalam kajian ini kerana lebih kurang 40 minit diperlukan untuk menghilangkan air kultur mikroalga sepenuhnya.

INVESTIGATION OF DIFFERENT HARVESTING METHODS FOR MICROALGAE *COCCOMYXA SP.* BIOMASS

ABSTRACT

Microalgae harvesting methods can currently be classified as mechanical, chemical, biological and electrical. Centrifugation, flocculation and filtration are among the top three preferred harvesting techniques to obtain microalgal biomass for applications such as biofuel, human and animal food, and water quality restoration. The present study investigated the variables affecting the biomass recovery efficiency via centrifugation, flocculation and filtration method. *Coccomyxa sp.* microalgae strain was locally isolated and cultivated for the investigation and comparison of harvesting efficiency for each method. Based on the results in this study, a centrifugal speed of 5000 rpm can give rise to harvesting efficiency >95% at 5 minutes. Centrifugation time at 2 minutes and above was capable of attaining >90% of microalgal biomass recovery while centrifugation time longer than 5 minutes did not show significant increase in harvesting efficiency. Both centrifugal speed and time exhibited significant effects on harvesting efficiency. For flocculation method, increasing the pH of microalgae culture to 10 induced autoflocculation of *Coccomyxa sp.* and 73.65% harvesting efficiency was reached at pH 11. However, there was no significant effect of pH from 5-9 on the formation of microalgal flocs. Flocculation using inorganic flocculant, CaCl₂ at pH 11 resulted in >90% harvesting efficiency at only 10 mg/ L CaCl₂. The highest efficiency was obtained at 150 mg/L CaCl₂, which was around 99.62%. There existed significant effects of both pH and dosage of flocculant on harvesting efficiency. Filtration successfully achieved the highest harvesting efficiency (99.65%) using a glass microfiber filter with pore size of 1.2 µm. However, it was very time consuming than other methods as it took around 40 minutes to completely dewater the microalgal culture.